Hager Environmental & Atmospheric Technologies
H.E.A.T.

Date: August 27, 2015

To: California Air Resources Board
1001 "I" Street
Sacramento, CA 95814

From: Yolla Hager
President, Hager Environmental & Atmospheric Technologies (H.E.A.T.)

Subject: Hager Environmental & Atmospheric Technologies (H.E.A.T.) comments on California Air Resources Board (CARB) and South Coast Air Quality Management District (SCAQMD) Draft Document Technology Assessment: Commercial Harbor Craft.

Introduction:

Hager Environmental & Atmospheric Technologies (H.E.A.T.) greatly appreciates the opportunity to comment on "Technology Assessment: Commercial Harbor Craft, August 2015." We are supportive and appreciative of California Air Resources Board (CARB) and South Coast Air Quality Management District's (SCAQMD) efforts to reduce NOx, GHG, and PM in the ports of California. With California being "a global gateway for goods," it sets a precedence for ports around the world for emissions reduction. Meeting goals of lowering the unhealthy levels of pollutants found around the ports from harbor crafts effecting highly populated areas surrounding epicenters of commerce is a commendable but challenging goal. H.E.A.T. recognizes the challenges that CARB and SCAQMD face, and we are prepared to contribute to the major goal of identifying and quantifying critical pollutants released in the ports in efforts to find solutions to reduce them.

H.E.A.T. offers a streamlined and accurate solution for detecting pollutants efficiently with the Emissions Detection and Reporting (EDAR) Active Remote Sensing System. H.E.A.T., founded in 2009, developed an advanced and unique technology, in its most complicated form, aimed at revolutionizing the Vehicle Emission Testing Industry. Since H.E.A.T.'s success in the vehicle emissions industry, they have expanded to various applications in different industries. Dr. J. Stewart Hager, inventor of EDAR, PhD Molecular Physicist, and founder of H.E.A.T. has over 25 years experience working with remote sensing technology and his previous work includes consulting with NASA Langley on the ASCENDS satellite. He works with a team of experienced engineers and technicians, cumulatively, which represents over 80 years of professional experience.

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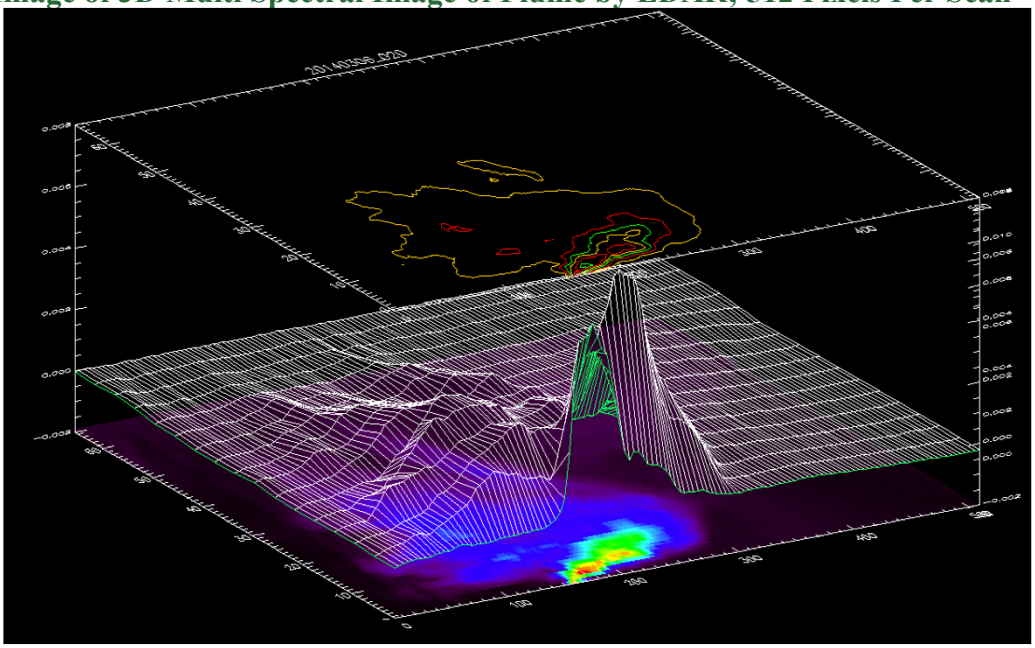
Company and Technology:

Hager Environmental & Atmospheric Technologies, LLC (HEAT) was founded in 2009 to develop an advanced and unique technology aimed at revolutionizing the Vehicle Emission Testing Industry. This technology, EDAR (Emissions Detecting And Reporting), is an eye safe laser-based technology capable of remotely detecting and measuring the infrared absorption of environmentally critical gases. EDAR contains a multi-patented system of hardware and software, which allows for a multi spectral 3-dimensional image (*Exhibit 1*) of the plume. Additionally, EDAR provides an increased sensitivity, in some cases of over 2,000%, and resolutions of a million times greater versus existing Remote Sensing technologies in use today.

Exhibit 1: Image of 3D Multi Spectral Image of Plume by EDAR; 512 Pixels Per Scan



Hager Environmental & Atmospheric Technologies, LLC
7308 Nubbin Ridge Drive
Knoxville, TN 37919
http://www.heatremotesensing.com

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HEAT's Emissions Detection and Reporting (EDAR) is an **active** remote sensing system. EDAR is a streamlined approach to accurately detecting and quantifying gases such as CO, CO2, NO, SO_2, total Hydrocarbons (HC) and also Particulate Matter (PM). Individual hydrocarbons such as Methane (CH_4), Ethane (C_2H_6), Ethylene (C_2H_4), Ethanol (C_2H_6O), and Propane (C_3H_8) can be measured separately from the total hydrocarbons. EDAR has an incredibly fast sampling rate of 20,000 Hz that allows us to ratio all other gases to CO2, because we are essentially measuring them at the same time. In addition to EDAR being an "all-in-one" system, it is unmanned while occupying a relatively small footprint, in a single location that is deployable in either a temporary or permanent application. All operations can be handled remotely once the unit is in place without any need for calibration. EDAR was initially developed to detect pollutants from a moving vehicles (*Exhibit 2*), but has the potential to be modified to suit virtually any application that requires gases to be detected and quantified remotely. In the case of shipping ports, EDAR can be placed either at a crane on the container terminal, under a bridge, or at the entrance of the port from the channel to detect and quantify critical pollutants such as NOx, SO_2, and PM from ships entering or docked in the harbor (*Exhibit 3*). The ports of Los Angeles, Long Beach, San Francisco and Oakland, among others, provide endless potential for locations to place or utilize an EDAR unit to capture each vessel.

Exhibit 2: EDAR's On-Road Footprint

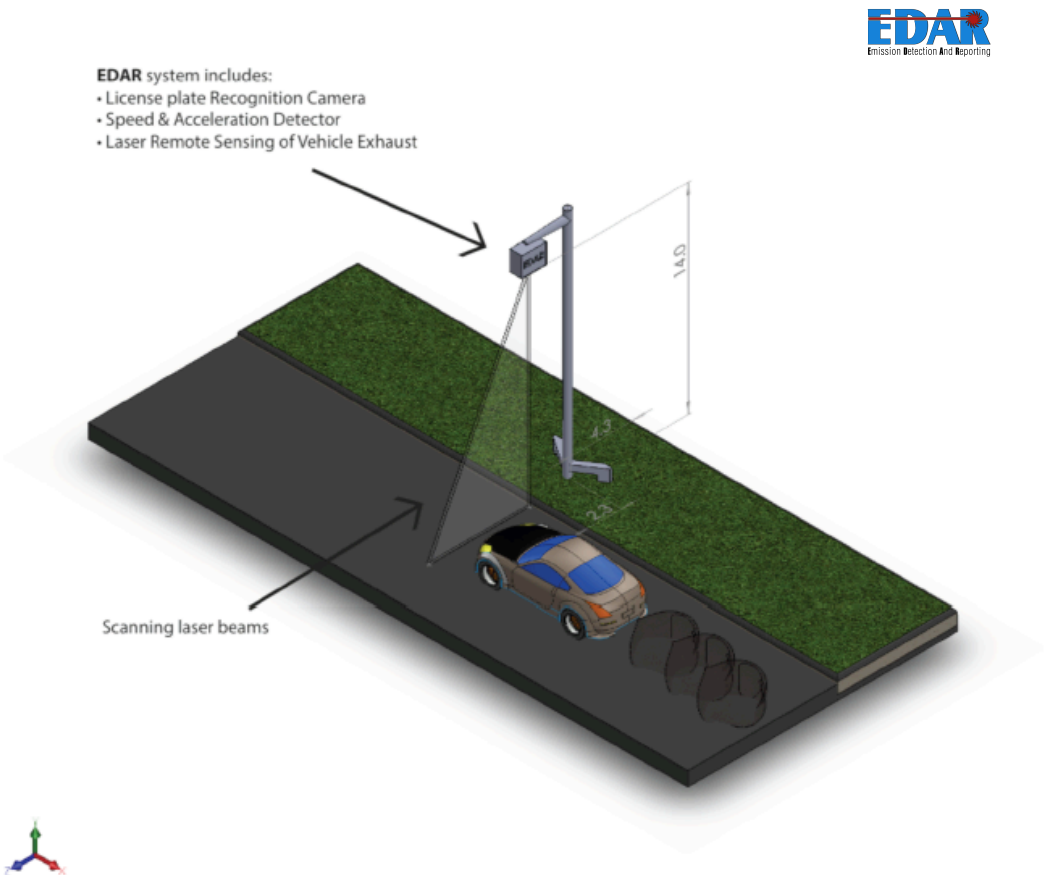

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Exhibit 3: EDAR's Footprint at the Port Container Terminal

Inventor and Expertise:

J. Stewart Hager, inventor and PhD Molecular Physicist, founded Hager Environmental & Atmospheric Technologies (H.E.A.T.). Dr. Hager has over 25 years experience working with remote sensing technology and his previous work includes consulting with NASA Langley on the ASCENDS satellite. He works with a team of experienced engineers and technicians, cumulatively, which represents over 80 years of professional experience.

The EDAR technology eliminates the need for calibration and is designed to collect data on various gases (i.e. CO, CO2, NOx, SO_2, CH_4, C_2H_6, C_2H_4, C_2H_6O, C_3H_8, total HC and PM) as part of an unmanned system. The integrity of EDAR's data has been validated by various studies comparing EDAR to a traditional Portable Emissions Measurement System (PEMS), other in-situ measurement devices.

Hager Environmental currently owns four patents (three issued and one pending), as well as significant trade secrets directly related to the EDAR technology and its use.

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How EDAR Can Contribute to the Shipping Industry in California:

- **Emissions Monitoring and Reduction:** EDAR can detect and quantify pollutants from ships as they are docked at the port or as they cross an entry into the port. Being able to identify the amounts of NOx, SO_2, and PM can greatly impact emissions reduction goals by recognizing the offending ships with a quantifiable image of the plume being emitted from the harbor craft/vessel.
- **Enforcement and Regulation:** By recognizing those offending ships, officials can effectively enforce port regulations and ensure compliance.
- **Inventory Tracking and Security:** Allows for a digital record, keeping track of the estimated 3800 commercial harbor craft, 2600 fishing vessels, and 600 various other ships in the port in 2015 alone.
- **Research and Reporting:** EDAR gives the ability to compare and contribute to the research being put forth in developing the new technologies (i.e. propeller systems, fuels, and engines) to test the efficacy of each new development though quantifiable data retrieved from the vessel in real-time.

Benefits of the EDAR System:

- **Reduction of Costs**: EDAR can be used as an un-manned, stand-alone system that minimizes costs by detecting and quantifying remotely using an Active Remote Sensing System.
- **Real Time Detection and Data:** EDAR has the ability to instantaneously provide a reading to engineers or operators.
- **Maximizes Air Quality Benefits**: Highest accuracy measurement of CO, CO2, CH_4, NO, NOx, SO_2, CH_4, C_2H_6, C_2H_4, C_2H_6O, C_3H_8, total HC and PM, which can be ratioed to CO_2.
- **Stealthy:** Unobtrusive system that allows for real world conditions to be analyzed in a timely manner.
- **Proven and Tested:** The EDAR unit has been repeatedly tested and validated in both real world and laboratory settings producing outstanding results that are comparable to in situ devices.
- **Recognition:** Studies recently presented by EPA stated that EDAR is "much more accurate than current remote sensing systems."[1]
- **Adaptability:** EDAR can be customized to suit various applications.
- **Advanced:** EDAR is an Active Remote Sensing system that ratios the detected gases to CO_2, as compared to commonly used Passive FTIR systems that are dependent on the physical environment and are low powered.

EDAR is "much more accurate than current remote sensing systems"

-United States Environmental Protection Agency (EPA)

Additional Notes:

[1] This is a direct quote presented by Constance Hart of the United States EPA in a presentation entitled "Canister Degradation Study" written by Constance Hart, David Hawkins, and Carl Fulper. This study was performed in conjunction with Eastern Research Group, SGS Environmental Testing Corporation, and H.E.A.T., LLC.

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